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whence $$\varepsilon^2 = 0{\cdot}211 = 1 - \frac{b^2}{a^2}$$

$$\therefore\ \frac{b^2}{a^2} = 0{\cdot}789$$

and $$\frac{b}{a} = 0{\cdot}8882$$

Hence $$e = 1 - \frac{b}{a} = 0{\cdot}1118 = \frac{1}{8{\cdot}94}$$

The resulting ellipticity deduced from the transverse diameters, as compared with the equatoreal diameters, is, therefore, larger by a trifling quantity than that deduced from the polar diameters, but the agreement between this result, Bessel's result from measures of polar and equatoreal diameters when the ring had nearly vanished, and my own published result, is surprisingly close,—the published result being the *smallest* of the three.

From all these circumstances I cannot help considering the determination of the ellipticity of *Saturn*, from the mean of the above three results, to be as certain as that of any astronomical element whatever, heretofore given.

I would finally remark, that the figure of *Saturn* drawn with my ellipticity, corresponds well with the image of *Saturn* which I saw so frequently during the disappearance of the ring; but that if I trusted solely to my impressions from memory, I should feel inclined to dissent from the result as being too small rather than too large.

Extracts of a Letter from the Rev. Mr. Stoddart, an American Missionary, to Sir John Herschel, Bart., dated Oroomiah, Persia, N. Lat. 37° 28′ 18″, *Long. E. from Greenwich* 45° 5′, *Oct. 29th,* 1852.

"No one has ever travelled in this country without being surprised at the distinctness with which distant objects are seen. Mountains fifty, sixty, and even a hundred miles off, are projected with great sharpness of outline on the blue sky; and the snowy peak of Ararat, the venerable father of mountains, is just as bright and beautiful when two hundred miles distant, as when we stand near its base. This wonderful transparency of the atmosphere frequently deceives the inexperienced traveller; and the clump of trees, indicating a village, which seems to rise only two or three miles before him, he will be often as many hours in reaching.

"In this connexion you will be interested to know that the apparent convergence of the sun's rays, at a point diametrically opposite its disk, which, if I mistake not, Sir David Brewster speaks of as a very rare phenomenon, is here so common that not a week passes in summer, when the whole sky at sunset is not striped with ribbons, very much like the meridians on an artificial globe.

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"But it is after nightfall that our sky appears in its highest brilliancy and beauty. Though accustomed to watch the heavens in different parts of the world, I have never seen anything like the splendour of a Persian summer evening. It is not too much to say that, were it not for the interference of the moon, we should have seventy-five nights in the three summer months, superior for purposes of observation to the very finest nights which favour the astronomer in the New World.* When I first came here I brought with me a six-foot Newtonian telescope of five inches aperture, of my own manufacture, and though the mirrors have since been much tarnished, and the instrument otherwise injured, its performance is incomparably superior to what it was in America. *Venus* sometimes shines with a light so dazzling, that at a distance of thirteen feet from the window I have distinguished the hands of a watch and even the letters of a book.

"Some few months since, having met with the statement that the satellites of *Jupiter* had been seen without a glass on Mount Etna, it occurred to me that I was in the most favourable circumstances possible for testing the power of the unassisted eye, and I determined at once to make some experiments on the subject. My attention was, of course, first turned to *Jupiter*, but for a considerable time with no success. It was always so bright, and shot out so many rays, that it seemed quite impossible to detect any of its moons, even at their greatest elongation from the planet. I varied the experiment in several ways, by looking through the tube of a small telescope, from which the lenses had been taken, and also by placing my eye near the corner of a building, so as to cut off the most brilliant rays of the planet, and yet leave the view unobstructed to the right hand or the left; but in neither case could I find any satellite. Sometime after I was sitting on the terrace, as daylight was fading into darkness, and thought I would watch *Jupiter* from its first distinct appearance till it shone out in its full splendour. This time I was exceedingly gratified just as stars of the first and second magnitude were beginning to appear, to see two, extremely faint points of light near the planet, which I felt sure were satellites. On pointing my telescope towards them, my first impressions were confirmed, and I almost leaped for joy. Since that night I have many times, at the same hour of the evening, had a similar view of these telescopic objects, and think I cannot be

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* Some five or six years since, Professor Sestini, now of the Georgetown College, near Washington, U.S., made in Rome a series of observations on the colours of stars, and he has lately been engaged in comparing these colours as seen in Rome and in Georgetown, the same telescope being used in both cases; and to prevent deception, he has always made the American observations before consulting the observations made at Rome. He says,—"The results are remarkably uniform; with a few exceptions much more so than I anticipated. So that, were the state of the air to be ranked among the causes of the different colours of celestial objects, it seems to me that there is but little difference between this atmosphere and that of Italy, even with regard to transparency." From this I think I can infer that this climate must be superior for astronomical purposes to that of Italy.

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mistaken as to the fact of their visibility. I must, however, add that none of my associates, who at my request have attended to the subject, are *sure* that they detect them, though the most sharp-sighted individual feels some confidence that he can do so. As these friends, however, are not practical observers, their failure to see the satellites does not shake at all my belief that I have seen them myself.

" The time during which these satellites are visible is hardly more than ten minutes. The planet itself soon becomes so bright that they are lost in its rays. I will not stop to discuss the question, in itself a most interesting one, why they are visible at all, when stars of the third and fourth magnitudes are not distinguishable, but merely give the facts in the case, knowing that you will reason on them far better than I can. Both the fixed stars and the planets shine here with a beautifully steady light, and there is little twinkling when they are forty degrees above the horizon.

" Having come to a satisfactory conclusion about the satellites of *Jupiter*, I turned next to *Saturn*. This planet rose so late in the night, that I had not seen it while watching *Jupiter*, and I was very curious to know whether any traces of a ring could be detected by the naked eye. To my surprise and delight, the moment I fixed my eyes steadily upon it, the elongation was very apparent, not like the satellites of *Jupiter*, at first suspected, *guessed* at, and then pretty clearly discernible, but such a view as was most convincing, and raised my wonder that I had never made the discovery before. I can only account for it from the fact that, though I have looked at the planet here with the telescope many times, I have never scrutinised it carefully with the naked eye. Several of my associates, whose attention I have since called to the planet, at once told me in which direction the longer axis of the ring lay, and that too without any previous knowledge of its position or acquaintance with each other's opinion. This independent collateral testimony is very satisfactory to me.

" I have somewhere seen it stated that in ancient works on astronomy, written long before the discovery of the telescope, *Saturn* is represented as of an *oblong* shape; and that it has puzzled astronomers much to account for it.* Am I not correct in this impression; and if so, is it not possible that here on these elevated and ancient plains, where shepherds thousands of years ago watched their flocks by night and studied the wonders of the glorious canopy over their heads, I have found a solution of the question?

" After examining *Saturn* I turned to *Venus*. The most I could determine with my naked eye was, that it shot out rays unequally, and appeared not to be round; but, on taking a dark glass of just the right opacity, I saw the planet as a very minute, but beautifully defined crescent. To guard against deception, I turned the glass different ways and used different glasses, and always with the same pleasing result. It may be that *Venus* can be seen thus in England and elsewhere; but I have never heard of the experiment being tried.

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* We suspect that Mr. Stoddart labours under an erroneous impression on this point, the observations which ascribed an oblong shape to the planet having been *subsequent* to the discovery of the telescope. It is well known that when Galileo first surveyed the planet with his newly-invented instrument, he found, *to his great surprise*, that it was shaped like an olive.—R. G.

" Let me say here that I find the naked eye superior for these purposes to a telescope formed of spectacle glasses, of six or eight magnifying power. This is not, perhaps, very wonderful, considering that in direct vision both eyes are used, without the straining of any one of the muscles around them, and without spherical or chromatic aberration or the interposition of a dense medium.

" As I am an entire stranger, and at the same time am desirous of having these statements make their full impression on your mind, it is proper for me to say that I was formerly for several years a pupil of Professor Olmsted, in New Haven, and have since been admitted to his special friendship: and that I was associated for some time in observations with young Mason, whose early death you have spoken of as a loss to the astronomical world; and though, no doubt, very many persons have more accurate habits of observation than myself, a practice of fifteen years has done much to train my eye for researches like these. You will also bear in mind the great dryness of our atmosphere, indicated by the register, as well as our great elevation. Captain Jacob (*Proceedings of the Edinburgh Royal Society*, vol. ii. No. 36), in speaking of the extinction of light in the atmosphere, says, 'the loss of light in passing from the zenith through a homogeneous atmosphere of 5·2 miles will be ·303. I was much astonished at first discovering that the air had so great absorbent powers, and many ideas are suggested by the fact.'

" My letter is already becoming tedious; but I will venture to trespass on your patience farther by naming a few test objects, which will enable you the better to compare the advantages of our position with your own.

" 1. δ *Cephei.* This I have looked at repeatedly with my naked eye; and though I cannot be *sure* that I have seen it double, I put it down in astronomical language as 'strongly suspected.'

" 2. The two small stars in the neighbourhood of the pole-star and in the general direction of γ *Cephei* are seen distinctly, and almost every night, as a single point of light.

" 3. 4 and 5 ϵ *Lyræ* are very beautiful and well defined. When lying on my back, the view of these stars, as they have passed near the zenith, has been very similar to that I have often had of *Castor* in a good telescope. There being *no dew* here, it is almost the universal custom for the people to sleep upon the terraced roofs, which gives them a fine opportunity, if so disposed, to gaze on the blue vault above them.

" 4. α *Libræ* is seen as two stars in any ordinary state of the atmosphere as readily as α *Capricorni* would be in America.

" 5. *Mizar* and *Alcor* in *Ursæ Major.* On looking at these

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any favourable night, two faint stars, which must be telescopic in England, are distinctly seen, one on each side of them."

On the Uranography of Saturn, including the Correction of certain Errors propagated generally in Scientific Works on that subject.

By Dr. Lardner.

After noticing the views entertained by other writers upon this subject, the author enters into a mathematical investigation of the true form, magnitude, and position of the projection of the rings, as seen from different latitudes of the planet.

If we suppose the observer stationed at any given latitude and a perpendicular drawn from his station upon the plane of the rings, this perpendicular will be the sine of his latitude, while the distance of this perpendicular from the centre of the rings will be the cosine.

If the observer were stationed anywhere in the axis of the planet above the plane of the rings, a visual ray proceeding from his station to one of the edges, and supposed to curve round that edge, would describe a right cone, the axis of which would coincide with that of the planet. The projection of the edges of the ring upon the firmament would be the intersection of the surface of this right cone with the celestial sphere, and would obviously then be a parallel to the celestial equator, whose declination would be the complement of the semi-angle of the cone.

But if the station of the observer be transferred from the axis of the planet to any point on its surface, then the cone formed by the visual ray will no longer be a right cone; it will, on the contrary, be an oblique cone, the obliquity of whose axis to the plane of the rings will be equal to the latitude of the observer. The projection of the rings upon the celestial sphere will be the intersection of this oblique cone with the surface of the sphere, and will, therefore, no longer be a parallel of declination. Different points of its projection upon the sphere will have different declinations; that point which is upon the meridian of the observer above the horizon having the greatest, and that which is upon the meridian below the horizon having the least declination. All the analytical formulæ necessary for the determination of this projection of each of the edges of the rings upon the firmament are given in the paper, and such of the formulæ as are necessary for the purpose are tabulated for every two degrees of latitude within the limits of latitude at which the rings are visible.

It appears from this, that the rings form upon the firmament of the observer zones, the edges of which are at variable distances from the celestial equator, the point of each edge which crosses the meridian being most remote from the equator, and the distance decreasing from that point to the horizon; the point of the edge which is upon the horizon being, therefore, nearer to the celestial